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## (54) COATED HARD MEMBER

### (57)Abstract:

**PURPOSE:** To increase the adhesion of a film and to improve wear resistance and breaking resistance by specifying the X-ray diffraction pattern of a film, in the member prepared by coating the surface of a base material with carbides, etc., of Ti and other specific elements by PVD method, etc.

**CONSTITUTION:** This coated hard member can be produced by coating the surface of a base material with the carbides, nitrides, and carbonitrides of binary system or ternary system selected from Ti, group IVa metals other than Ti, group Va metals, group VIa metals, and Al by PVD or CVD method. Further, when the peak intensity in (200) plane in the X-ray diffraction pattern of the film is  $I(200)$  and also the peak intensity in (111) plane is  $I(111)$ ,  $I_a$  value represented by equation  $I_a = I(200)/I(111)$  is  $\geq 1.5$ . The  $I_a$  value can be regulated by the bias voltage value, and, at medium voltage (50-100V), residual stress is decreased because of proper ion bombardment and adhesion is increased. When  $I_a$  value exceeds 1.5, the critical load value by a scratch testing machine is increased and adhesion is improved.

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## DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] this invention relates to the covering hard member used as the cutting tool excellent in abrasion resistance and deficit-proof nature, and an abrasion-resistant tool.

[0002]

[Description of the Prior Art] Many covering hard members which used the hard film of carbide, such as Ti and Zr, a nitride, and a charcoal nitride by the physical vapor deposition (PVD is called hereafter.) or the chemical vapor deposition (CVD is called hereafter.) are used for the base front face the sake [ on the abrasion resistance of a cutting tool or an abrasion-resistant tool, and a deficit-proof disposition ]. Since the covering hard member produced especially by PVD has membrane formation temperature as low as 500 degrees C. or less, it does not almost have the reaction of a coat and a base material, and can harness base material intensity. Therefore, it is mostly used to the throwaway tip for milling cutter cutting, an end mill, etc. now.

[0003] However, since cutting of high degree-of-hardness material and improvement in the speed of a cutting speed are progressing recently and thermal resistance is inferior in carbide, such as Above Ti and Zr, a nitride, and a charcoal nitride, when the edge of a blade becomes an elevated temperature, a coat deteriorates and a cutting life is short. Then, N film excellent (Ti, aluminum) in oxidation resistance comes to attract attention, and development is furthered. This film demonstrates the performance excellent also in the field of high speed cutting in which it excels in thermal resistance and the edge of a blade becomes an elevated temperature from the aforementioned hard film, and is firmly excellent also in abrasion resistance with Vickers hardness 2300-3000 further. Moreover, the patent (U.S. JP,4871434,B) about JP,5-57705,B which limited the ratio of Ti/aluminum as an improvement proposal, or coats further formed into many dimensions, such as N (Ti, aluminum, Zr) and N (Ti, aluminum, V), is also proposed.

[0004] Furthermore, when carbide, such as Ti and Zr, and a nitride are formed on a base by PVD, CVD, etc., the coat which carried out orientation to the specific field according to the crystallinity on the front face of a base and the gas atmosphere in membrane formation equipment, and conditions can be obtained. The covering hard metal with which it comes strongly to carry out orientation of the crystallinity of the coat of the carbide of Ti, Zr, and Hf which were covered by cemented carbide or the base front face of a cermet, a nitride, and a charcoal nitride to JP,56-156767,A to a field (200) is indicated. Thus, by controlling the crystal stacking tendency of the coat formed, a film property can be raised and the abrasion resistance of a covering hard metal and deficit-proof nature improve.

[0005]

[Problem(s) to be Solved by the Invention] Therefore, in order for the property of a coat to also change by the Ti/aluminum ratio about the aforementioned (Ti, aluminum) N film, it is difficult to obtain the film of a high degree of hardness. Furthermore the crystal stacking tendency of a coat is not examined and a problem is in the adhesion of a coat and a base. this invention -- the aforementioned trouble -- solving -- hard -- a member -- when making the carbide of the 2 yuan system chosen upwards from periodic tables 4a and 5a other than Ti and Ti, 6a group, and aluminum, or a 3 yuan system, a nitride, and a charcoal nitride cover, the crystal stacking tendency of a coat is made the optimal therefore, the covering hard which raised adhesion and was excellent in abrasion resistance and deficit-proof nature -- it aims at offer of a member

[0006]

[Means for Solving the Problem] this invention person found out that there was optimal crystal orientation side, as a

result of covering the nitride of a 2 yuan system chosen as a superhard member front face from periodic tables 4a and 5a other than Ti and Ti, 6a group, and aluminum and examining adhesion of the crystal stacking tendency of a coat, and a base. The covering hard member of this invention by PVD or CVD on a base front face Namely, periodic-table 4a other than Ti and Ti, In the covering hard member which comes to cover the carbide of 5a, 6a group, the 2 yuan system chosen from aluminum, or a 3 yuan system, a nitride, and a charcoal nitride When peak intensity of I (200) and a field (111) is set to I (111) for the peak intensity of the field in the X diffraction pattern (200) of a coat, it is  $I_a = I(200)/I(111)$ .

It comes out and is characterized by  $I_a$  value expressed being 1.5 or more. Moreover, it is characterized by making into the multilayer more than two-layer the layer chosen from one of the layer of the aforementioned coat, the carbide of AlN, periodic tables 4a and 5a, and 6a group, a nitride, and charcoal nitrides.

[0007]

[Function] Various alloy targets are prepared for Table 1, and the evaluation result of the critical load value by the scratch testing machine in case 3 micrometers of bias voltage values are produced on condition that inside voltage (50-100V), the high voltage (150-200V), and a ten to 1 Pa reactant gas (nitrogen) pressure and the aforementioned  $I_a$  values differ various coats is shown in it by the arc ion plating method. In addition, the base used for membrane formation is the sintered carbide tool of 84WC-3TiC-1TiN-3TaC-9vol%Co composition.

[0008]

[Table 1]

番号	膜質	ピーク強度比	臨界荷重値 (N)	バイアス電圧値 (V)
比較例	1 (Ti、Al)N	1.2	31	150
	2 (Ti、Zr)N	0.9	27	200
	3 (Ti、V)N	1.1	24	180
	4 (Ti、Hf)N	0.8	25	160
	5 (Ti、Cr)N	1.4	28	150
	6 (Ti、Nb)N	1.0	21	190
本発明例	7 (Ti、Al)N	2.3	54	80
	8 (Ti、Zr)N	1.6	50	90
	9 (Ti、V)N	2.5	45	60
	10 (Ti、Hf)N	3.1	47	90
	11 (Ti、Cr)N	2.7	51	60
	12 (Ti、Nb)N	1.9	42	70

[0009] By the way, the value of  $I_a = I(200)/I(111)$  can be adjusted with a bias voltage value from Table 1. In inside voltage and a low bias voltage value, although residual compression stress is also small excellent in adhesion for the suitable ion bombardment, if it is made a high bias voltage value, an ion bombardment will become large, residual compression stress will also become large, and a film will become easy to exfoliate. However, since ion bombardment conversely sufficient with the low bias voltage value below 50V is not obtained, a film will exfoliate. Therefore, inside voltage was made into the rated-bias voltage value in the arc ion plating system used for this examination.

[0010] When  $I_a = I(200)/I(111)$  exceeds 1.5 in every coat after this, it turns out that a critical load value becomes large and adhesion improves. From this, the value of  $I_a$  was determined or more as 1.5. this invention is applicable also to carbide and a charcoal nitride besides the aforementioned nitride. Moreover, this invention is applicable also to periodic tables 4a and 5a other than Ti and Ti, 6a group, the carbide of the 3 yuan system chosen from aluminum, a nitride, and a charcoal nitride. this invention does not limit the base which forms a coat and should just choose it suitably further again according to uses, such as WC cemented carbide, a cermet, a high speed steel, or a wear resistant alloy. Hereafter, an example explains this invention in detail.

[0011]

[Example] it becomes composition of 84WC-3TiC-1TiN-3TaC-9vol%Co -- as -- WC powder of 2.5 micrometers of commercial mean particle diameters -- said -- 1.5-micrometer TiC powder and this TiN powder -- said -- 1.2-micrometer TaC powder was mixed with the ball mill for 96 hours, the throwaway tip of SEE42TN was pressed after the dryness granulation, and the predetermined tool configuration was processed after sintering

[0012] Various alloy targets were prepared by the arc ion plating method on this chip, and the coat as shown in Table 2 was formed. And it asked for the length of cut until the following cutting conditions perform a milling cutter cutting examination and the maximum abrasion loss amounts these coated carbide tools to 0.2mm. The result is written together to Table 2.

\*\*ed material SKD61 cutting speed It sends 250 m/min. 0.2mm / edge slitting 2.0mm cutting oil Nothing tool configuration SEE42TN-G9Y. [0013]

[Table 2]

番号		膜厚 $\mu\text{m}$	ピーク強度比	切削長 ( $\text{m}$ )	摩耗状態
従 来 例	1	3	1. 2	2. 3	正常摩耗
	2	3	0. 9	2. 1	"
	3	3	1. 1	1. 9	剥離による異常摩耗
	4	3	0. 8	1. 7	"
	5	3	1. 4	2. 2	"
	6	3	1. 0	2. 1	"
本 発 明 例	7	3	2. 3	2. 9	正常摩耗
	8	3	1. 6	3. 1	"
	9	3	2. 5	2. 7	"
	10	3	3. 1	3. 0	"
	11	3	2. 7	2. 8	"
	12	3	1. 9	2. 7	"

[0014] From Table 2, since it has the outstanding abrasion resistance that a length of cut until the maximum abrasion loss gives each to 0.2mm rather than the conventional material is prolonged and the adhesion of a coat is excellent, this invention material 7-12 shows the cutting-ability ability in which a chipping which was seen by the conventional material, and KAKE were excellent few.

[0015]

[Effect of the Invention] by having 1.5 or more coats, intensity-ratio  $I_a=I(200)/I(111)$  of an X diffraction pattern raises adhesion with a base, is excellent in abrasion resistance, and is markedly alike, and, as for the covering hard member of this invention, a long life is acquired

[Translation done.]

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CLAIMS

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[Claim(s)]

[Claim 1] In the covering hard member which comes to cover the carbide of the 2 yuan system chosen as a base front face by PVD or CVD from periodic tables 4a and 5a other than Ti and Ti, 6a group, and aluminum, or a 3 yuan system, a nitride, and a charcoal nitride When peak intensity of I (200) and a field (111) is set to I (111) for the peak intensity of the field in the X diffraction pattern (200) of a coat, it is following formula  $I_a = I(200)/I(111)$ .

the covering hard which comes out and is characterized by  $I_a$  value expressed being 1.5 or more -- a member

[Claim 2] the layer of the aforementioned coat, the carbide of AlN, periodic tables 4a and 5a, and 6a group, a nitride, a charcoal nitride, and \*\* -- the covering hard according to claim 1 characterized by making into the multilayer more than two-layer the layer chosen from one inside -- a member

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[Translation done.]